Original Research

Call Accuracy and Distance from the Play: A Study with Brazilian Soccer Referees

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ABSTRACT

Int J Exerc Sci 4(1) : 30-38, 2011. Refereeing decisions in soccer has always been a controversial issue. In order to better understand this subject, foul calls made by Brazilian soccer referees were evaluated to determine the potential relationship between the distance from the referee to a foul play and the accuracy of the call. Soccer matches supervised by the São Paulo State Football Federation were recorded and 321 foul calls were analyzed. No significant association was found between the referee's distance from a foul play and accuracy of the call (p = 0.561). However, there was a significant increase in the number of correct calls in the last 15 minutes of the second half compared with the number of correct calls in the first 30 minutes of the same half (p = 0.003).

KEY WORDS: Decision-making skills, match analysis, fitness level, peripheral vision

INTRODUCTION

It is well known that soccer is a very popular sport. Soccer playing is characterized by non-cyclic, intermittent physical activity of aerobic and anaerobic nature (1, 7, 19, 22). The referee is in charge of administering the match, assuring that the rules are observed, and is the one who takes disciplinary action when necessary. Therefore, the referee is required to be physically, technically, and psychologically fit in order to have a good performance throughout the match.

Being in the right place at the right time, so that the soccer rules are correctly applied, is directly associated with the fitness level of the referee (16). Several authors have recommended special attention to fitness programs for referees, consisting of intermittent sessions of aerobic exercises combined with activities to increase speed, agility, and the range of movements. Thus, the frequent assessment of aerobic and anaerobic performance is also a concern (3, 6, 12, 13, 23, 21).

A referee should also thoroughly know the soccer rules and apply them wisely, while avoiding emotional factors that can influence his or her decisions (2, 25). Moreover, the referee should be in a good position to have the best view of the play

(21). Fast decision-making based on the referee's good judgment, technical exactness, impartiality, and immediate action contribute to the successful outcome of a soccer match (14).

The experience of the referee is directly related to the number of correct calls (18). On the other hand, inaccurate calls can generate feelings of irritation and perception of partiality in the players (25).

Elliot and Mester (8) defined perception as the way a person processes (broadly understands) a variety of data or ongoing events, on both external (surroundings) and internal (within oneself, including bodily attitudes) environments.

In humans, vision can be considered the most important sense for acquiring information from the environment. The ability of a referee to perceive fast moving players, in sequential or simultaneous movements, depends on the visual awareness, a factor that may affect the referee's judgment in a variety of situations (26). Some authors focused their studies on the referee's peripheral vision and its relationship to right and wrong refereeing calls during actual situations (15, 21, 26).

An increase in trait anxiety and state-anxiety can also influence sport performance, because of changes in the state of attention and concentration (17). A high level of activation may result in a narrowing of the field of attention of a person. In psychological terms, a narrow field of attention may negatively affect the performance of tasks that require attention in a wide variety of circumstances (30). The level of activation or state anxiety may result in diminished perception and awareness of the environment, causing a shift to a state of concentrated attention and inadequate information processing. As a result of high cognitive state anxiety, referees may become very self-critical and start "worrying about worry", which does not allow the individual to reach an optimal state of attention (30).

A referee's wrong decision may also be associated with his or her positioning during the soccer match. In order to minimize problems with visualization and positioning during a match, the Fédération Internationale de Football Association (FIFA, 1982) established a diagonal system of control for referees. The diagonal system is designed to facilitate a good view of play and, therefore, good decision-making for both the referee and his/her assistant referees, who are meant to work together as a team. Referees are advised to move diagonally on the field, from corner to corner, and to avoid being ahead of the ball in order to get a better view of the game. This diagonal motion should also be in the opposite direction to the assistant referee's motion, so that the referee is in a part of the playing field, where he or she can be helped by the assistant's view of the field. FIFA has also experimented with two additional assistant referees, who are positioned on the opposite side of the goal to the assistant referees to provide the widest possible cover of the penalty area by the match referees.

Brazilian soccer referees are required to undergo technical refereeing training. However, there are some unanswered questions regarding subjective factors influencing the decisions made by referees in Brazil. Currently, there are only a few studies addressing the accuracy of

refereeing decisions in soccer based on the distance the referee stood from the foul play. The present study intended to add information and improve the understanding of this subject.

The objectives of this study were to determine the mean distance a referee was when he or she called a foul, verify whether this distance was related to right or wrong decision-making, and determine whether the pattern of foul calls and distance from the referee to a foul play changed during soccer matches.

METHODS

Participants

This study was approved by the Research Ethics Committee of the Federal University of São Paulo (UNIFESP), Brazil, under the process number CEP 0213/03. Written informed consent was obtained from all participants with the knowledge that they were free to leave the study at any time. A total of 369 foul calls were recorded for analysis during official matches of the Brazilian Under-20 Championship (U-20) 2002 assigned at random by the São Paulo State Football Federation. The U-20 is an official competition sponsored by the São Paulo State Football Federation for players younger than 20 years of age.

All referees who participated in this study underwent periodic visual acuity testing in which it was reported that they all had excellent vision. The test results are available on file.

Protocol

The instruments and materials used for recording the matches were a digital video camera HANDYCAM™ model DCR, a Velbon™ DF-30 portable camera stand, a Feeling™ measuring tape, a SPORT™ chronometer and SONY™ tapes for digital recording.

Match Recording

According to Helsen and Bultynck (12), decision-making is the most important aspect of refereeing, and these authors have suggested the use of video-replay analysis as a strategy to improve the decision-making skills of referees. The camera was always placed in the area assigned to the broadcast teams in a high and central location in the stands. Zoom was not used during the recording of the match. The dimensions of the soccer fields were measured for further computer graphic analysis using the Discreet 3D Studio Max 4.0 software. After the end of a match, the corresponding videotape was examined and, at the moment the referee's whistle was heard, the image was frozen and captured by the Perception video editing package (Perception PVR-2500, Digital Processing Systems) for graphic analysis. According to the Official Rules of Soccer (rule 5), the referee at his/her discretion can accept or not the indications of the assistant referees with respect to foul plays regardless of the distance between the assistants and the play. The plays for which the referee consulted with the assistant referees were excluded from this study.

The mentioned above procedures were utilized since other authors also made this type of analysis using real time video and computer software (5, 12, 20, 24, 32).

Determination of Right or Wrong Calls

A compact recording, which only contained plays resulting in foul calls, was shown to three renowned elite referees (reviewers)

who have been administering matches of the São Paulo State First Division Championship for more than three years. The reviewers belonged to soccer leagues different from those of the referees being evaluated, and did not maintain any contact with them. These professionals were informed about the purpose of the present study and signed an informed consent. Each reviewer received a fill-in form containing a number corresponding to the foul play exhibited in the recordings followed by three boxes under the legend CORRECT DECISION, INCORRECT DECISION, and IMPOSSIBLE TO DETERMINE from which just one was to be checked. They were free to watch each play as many times as they would like to. All reviewing work of each reviewer was done independently.

The present study adopted, as reference in the reviewing of foul calls, the procedures described by other researchers (10, 11), who analyzed foul plays with card punishment. From a total of 369 plays called as fouls, 48 were excluded from the study because they were marked as 'IMPOSSIBLE TO DETERMINE', resulting in 321 foul calls, which were statistically analyzed.

It was hypothesized that physical and psychological demands on referees would increase along the match, and a natural decrease in the accuracy of the referee's decision would occur. In order to test this hypothesis, the frequency of foul calls within consecutive periods of 15 minutes of play, and the respective percentage of correct and wrong foul calls were analyzed.

Statistical Analysis

The Student's t-test was used to determine differences between the distances from the referee to the foul play, and the paired t-test was used to compare the distances covered by the referee in the first and second halves of the match. The association between the referee's distance from the play and accuracy of the call was determined with the chi-square test. Analysis of variance (ANOVA) was used to compare the distances from the referee to the foul play at each 15-minute period of the match. All statistical tests were performed at a significance level of $p \leq 0.05$. Data were expressed as mean ± standard deviation.

RESULTS

Table 1 shows the frequency distribution of right and wrong calls with respect to the referee's distance from the foul play. There were no significant associations between the mean distance from the referee to the foul play and accuracy of the referee's decision, although the highest percentage of correct calls occurred for distances ranging from 20.1 to 25.0 meters.

Tables 2, 3 and 4 show the frequency of foul calls within consecutive periods of 15 minutes of play, and the respective percentage of correct and wrong foul calls. No significant differences were found in the accuracy of the referee's decision between the 15-minute periods during the first half of the match. However, there was a significant increase in the referees' decision accuracy in the last 15 minutes of the match compared with the first two 15-minute periods of the second half of the match.

Table 1. Frequency of foul calls and the accuracy of the referees' decision according to their distance from the foul play ($p = 0.561$).

Distance	Decision

(m)	Correct	Incorrect	Total
0 to 15.0	144	56	200
	72.0%	28.0%	100 %
15.1 to 20.0	47	23	70
	67.1%	32.9%	100 %
20.1 to 25.0	25	6	31
	80.6%	19.4%	100 %
25.1 and up	15	5	20
	75.0%	25.0%	100%
Total	**231**	**90**	**321**
	72.0%	28.0%	100 %

Table 5 lists the mean distance between the referee and foul play for each 15-minute period of the match. There were no significant differences between the distances from the referee to the foul play neither in the first (p = 0.587) nor second (p = 0.890) half of the matches.

There were no significant associations between the mean distance from the referee to the foul play and accuracy of the referee's call (p = 0.446).

Table 2. Frequency of foul calls and the accuracy of the referees' decision within periods of 15 minutes during the first half of the match (p = 0.175).

Time	Decision		
(min)	**Correct**	**Incorrect**	**Total**
0 – 15.0	39	7	46
	84.8%	15.2%	100 %
15.1 – 30.0	47	19	66
	71.2%	28.8%	100 %
30.1 and up	40	17	57
	70.2%	29.8%	100 %
Total	**126**	**43**	**169**
	74.6%	25.4%	100 %

Table 3. Frequency of foul calls and the accuracy of the referees' decision within periods of 15 minutes during the second half of the match (p = 0.614).

Time	Decision		
(min)	**Correct**	**Incorrect**	**Total**
0 – 15.0	25	21	46
	54.3%	45.7%	100 %
15.1 – 30.0	39	19	58
	67.2%	32.8%	100 %
30.1 and up	41	7	48
	85.4%	14.6%	100 %
Total	**105**	**47**	**152**
	69.1%	30.9%	100 %

Table 4. Accuracy of the referees' decision during the initial two-thirds and last third of the match's second half (p = 0.003).

Time	Decision		
(min)	**Correct**	**Incorrect**	**Total**
0 – 30.0 min	64	40	104
	61.5 %	38.5 %	100 %
30.1 and up	41	7	48
	85.4 %	14.6 %	100 %

Total	**105**	**47**	**152**
	69.1 %	30.9 %	100 %

DISCUSSION

Soccer is a sport played by a large number of professionals, amateurs, and leisure-time players, and has an even larger number of fans. Naturally, soccer issues result in a good deal of controversy and heated arguments.

A factor that most probably would affect referee's perception and, consequently, the correctness of a foul call, is surely the distance the referee keeps from the ongoing play. There are few studies in the specialized literature on the referees' perception and the ideal distance they should keep from the player(s) who is (are) controlling the ball, or else will receive the ball (4, 8, 26, 27).

The referee's distances from foul plays were collected from 90-minute standard-duration matches. The independent review of 321 foul calls by three renowned top-class referees indicated a non-significant trend towards a higher percentage of calls confirmed as correct (80.6%) when the referee administering the match was positioned between 20.1 and 25.0 meters from the play, as shown in Table 1. However, there was no significant association between correct calls and the referee's distance from the play.

Table 5. Mean distance from the referee to the foul play during matches.

Half	**Time (min)**	**Mean Distance (m)**	**Standard Deviation (m)**	**N**
First	0 – 15.0	13.724	5.7933	46
	15.1 – 30.0	13.558	5.8167	66
	30.1 and up	14.230	6.7917	57
	Total	**13.830**	**6.1272**	**169**
Second	0 – 15.0	14.617	6.6849	46
	15.1 – 30.0	13.078	5.9541	58
	30.1 and up	13.525	6.2062	48
	Total	**13.685**	**6.2532**	**152**
Mean	0 – 15.0	14.171	6.2367	92
	15.1 – 30.0	13.333	5.8622	124
	30.1 and up	13.908	6.5092	105
	Total	**13.761**	**6.1779**	**321**

In a similar study, Verheijen et al. (29) analyzed a total of four 60-minute elite youth soccer games administered by three referees and assessed by three official observers of the Royal Netherlands Football Association. The authors reported that a larger number of decisions were confirmed as correct when the referee stood at 17.74 ± 7.58 meters than at 12.68 ± 5.68 meters from the play.

In the present study, the analysis of the mean percentage distribution of correct decisions made by a referee in each 15-minute period of the matches (Tables 2 and 3) did not reveal any significant differences between the first (74.6%) and second (69.1%) halves of the match, or even within the first half. During the second half (Table 4), however, the percentage of correct

decisions in the last 15 minutes (85.4%) was significantly higher compared with the first two 15-minute periods (54.3% and 67.2%, respectively).

Tzouvaras (28) reported that almost two-thirds of foul plays occur in the second half of matches, and that the increase in the number of referee's wrong decisions could be attributed to an increase in physical demands on the referees. Nevertheless, in the present study, it was observed that the frequency of foul calls had a quite homogeneous distribution during the match (Table 5). One would expect that the physical demands on the referees in the final 15 minutes of the match would increase, and a natural decrease in the quality of the referee's decision would occur, as reported by Tzouvaras (28). However, our results clearly contradicts this reasoning by showing an increase in the percentage of correct calls from 54.3% (first 15-minute period of the second half) to 85.4% (last 15-minute period of the second half), which is a value very similar to that found in the first 15 minutes of the match (84.8%). See Tables 2 and 3.

The fact that referees were more alert and focused, and made fewer mistakes at the end of the matches may be attributed to a lower level of anxiety and activation, possibly because the referees knew the end of the match was near. According to Nideffer (30) these factors may have a direct influence on the actions and performance of referees and players.

According to D'Ottavio and Castanha (5), another possible explanation for the significant differences in the accuracy of the referee's decision within the second half of the matches, could be differences in the distance the referees kept from the ongoing play. However, in the present study, no significant differences were found in the mean distance from the referee to the foul play between the 15-minute periods of the soccer matches (Table 5).

The pace of professional soccer matches has markedly increased in the last 20 years and, as a consequence, it is becoming more difficult for referees to follow the play and make correct decisions.

It seems that a thorough understanding of the factors influencing the accuracy of a referee's decision is still to be achieved. There are only a few studies on the referee's distance from the play; the different methodologies used, study subjects, and/or environmental conditions compromise an in-depth comparison of findings between studies. Therefore, further studies using the same methodology used here, applied to referees administering matches of the Brazilian Top Division championship league should be carried out to confirm whether the findings of this study still hold true. Furthermore, psychological variables should also be better controlled and a greater use of electronic aids, such as a micro-camera carried by the referee, would certainly provide a more detailed description of the environment perceived by the referee.

The fact that only U-20 matches were analyzed in this study reduces the generalization of results to other soccer leagues. The distance to the foul play is only one of the variables involved in the referee's ability to make a correct call. The level of activation and anxiety of referees should also be investigated in future studies.

Our results indicated that the highest percentage of correct calls occurred for distances ranging from 20.1 to 25.0 meters. This suggests that the referees should not be too close to the play, so that they have a better peripheral vision, which may increase the number of correct calls.

The increased number of correct calls in the last 15 min of the match may be associated with decreased levels of activation and anxiety. When referees are confident that they have performed well, they can judge plays with more tranquility, resulting in a lower state of activation in the last minutes of the match.

We suggest the use of technology to minimize the impact of refereeing errors, which frequently are a consequence of inevitable physical and visual constraints. Refereeing errors interfere negatively in the result of a match and their consequences can be very detrimental to the sport as a whole, because teams may be unjustly eliminated from competitions, and championships may be decided on bad calls, resulting in financial loss, and creating frustration and anger among fans.

It is clear that an action must be taken by FIFA. Possibly, the use of additional assistant referees may improve the current situation; however, refereeing errors and bad calls can also occur in different parts of the playing field other than the penalty area. Difficult or controversial calls could be reviewed with the help of video cameras and analyzed by the referees and match supervisors in the field.

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